



**National  
Transportation  
Safety Board**

# Managing Fatigue in Aviation Ops: An NTSB Perspective

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Board Member

The Twin Cessna Flyer Convention  
June 28, 2013



- 1) determining the probable cause of transportation accidents**
- 2) making recommendations to prevent their recurrence**



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# All Modes



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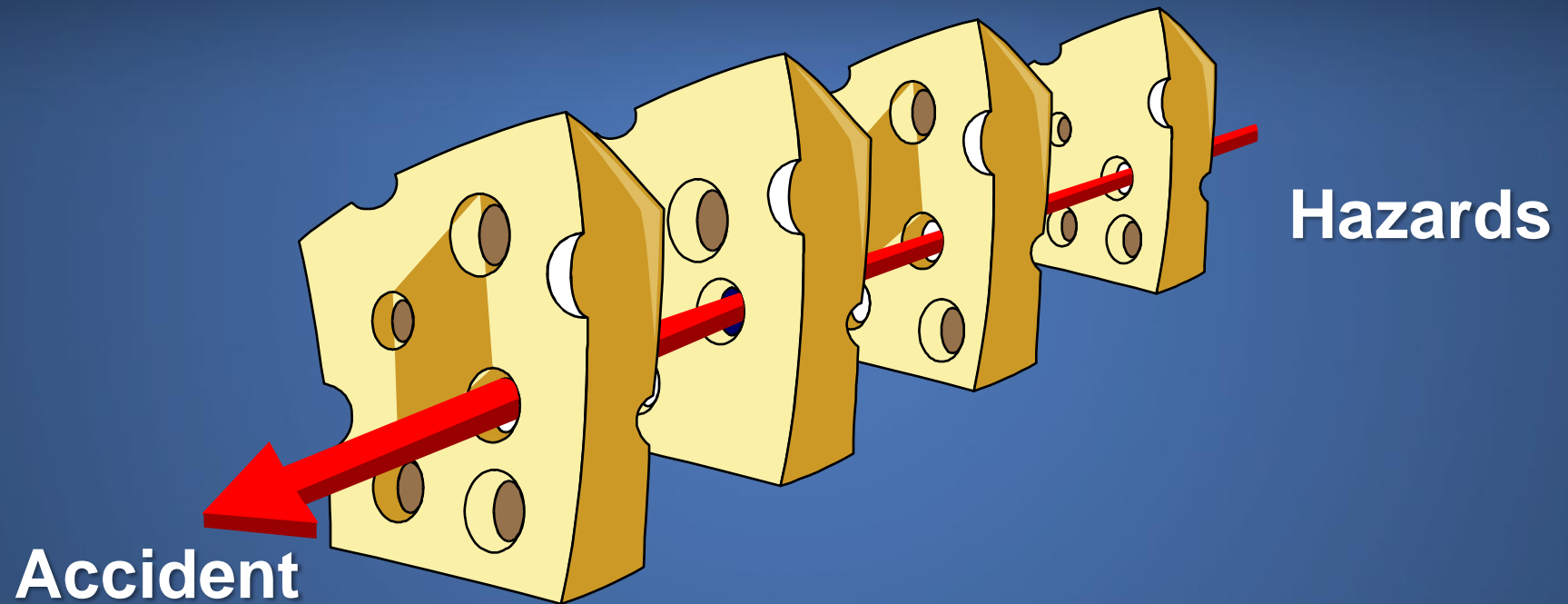
# Independent Federal Agency: Created in 1967

- ~ 132,000 accident investigations
- 13,500+ safety recommendations
- ~ 2,500 organizations/recipients
- 82% acceptance rate





# “Swiss Cheese” Model (Reason)



Successive layers of defenses, barriers, and safeguards



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# NTSB Characterized as:

‘moral compass and industry conscience’

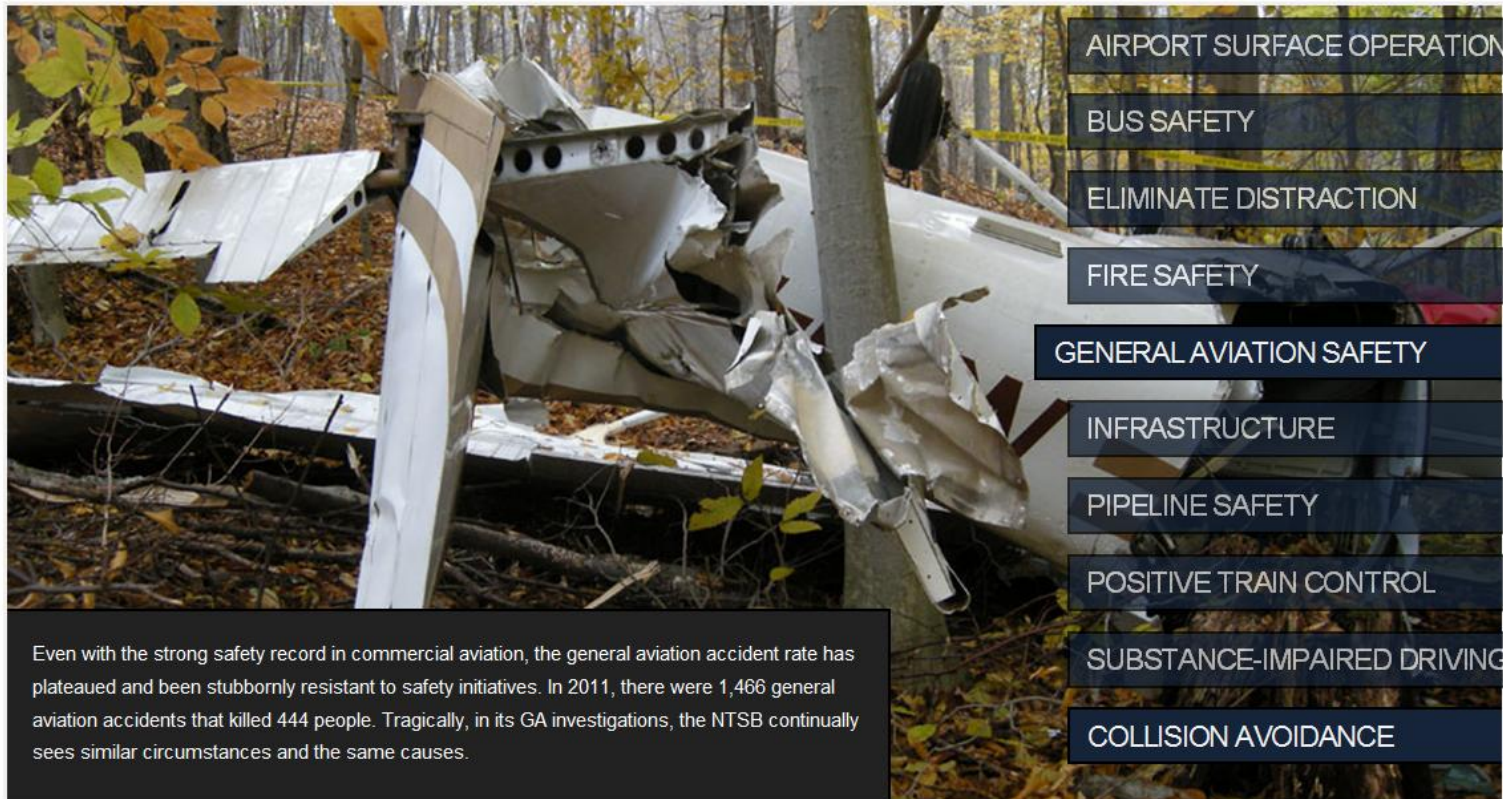
NTSB Chairman Deborah A.P. Hersman



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## MOST WANTED LIST

The Most Wanted List represents the NTSB's advocacy priorities. It is designed to increase awareness of, and support for, the most critical changes needed to reduce transportation accidents and save lives.



Even with the strong safety record in commercial aviation, the general aviation accident rate has plateaued and been stubbornly resistant to safety initiatives. In 2011, there were 1,466 general aviation accidents that killed 444 people. Tragically, in its GA investigations, the NTSB continually sees similar circumstances and the same causes.

AIRPORT SURFACE OPERATION

BUS SAFETY

ELIMINATE DISTRACTION

FIRE SAFETY

GENERAL AVIATION SAFETY

INFRASTRUCTURE

PIPELINE SAFETY

POSITIVE TRAIN CONTROL

SUBSTANCE-IMPAIRED DRIVING

COLLISION AVOIDANCE



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## NTSB SAFETY ALERT

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### ★ In-Cockpit NEXRAD Mosaic Imagery ★

*Actual Age of NEXRAD Data Can Differ Significantly  
From Age Indicated on Display*

#### The Problem

- Weather radar "mosaic" imagery created from Next Generation Radar (NEXRAD) data is available to pilots in the cockpit via the flight information service-broadcast (FIS-B) and private satellite weather service providers.
- A mosaic image presents radar data from multiple radar ground sites on a single image on the cockpit display. When a mosaic image is updated, it may not contain new information from each ground site.
- The age indicator associated with the mosaic image shows the age of the actual data. Instead, the age indicator shows the age of the service provider. Weather service providers can update the age indicator older than the age indicated on the display.
- Due to latencies inherent in the ground site to the cockpit display process, the age indicator can differ significantly by the time it is displayed.
- Although such situations are rare, the age indicator can EXCEED the age indicated on the display.
- Even small time differences can be important for safety of flight, especially in the case of hazardous weather conditions.

<sup>1</sup> Actual maximum age differences can



## NTSB SAFETY ALERT

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### ★ Meteorological Evaluation Towers

*Pilots urged to be vigilant for  
Meteorological Evaluation Towers*

#### The Problem

- Meteorological Evaluation Towers (METs) are used to measure wind speed and direction during the development of wind energy conversion facilities. METs are made from galvanized tubing (or other galvanized structure) with a diameter of 6 to 8 inches and are secured with guy wires that connect at multiple heights on the MET and anchor on the ground.
- Many METs fall just below the 200-foot Federal Aviation Administration (FAA) threshold for obstruction markings. They can also be erected quickly and without notice to the local aviation community, depending upon their location.
- Because of their size and color, pilots have reported difficulty seeing METs from the air. Therefore, METs could interfere with low-flying aircraft operations, including those involving helicopter emergency medical services, law enforcement, animal damage control, fish and wildlife, agriculture, and aerial fire suppression.
- The NTSB has investigated several fatal accidents involving aircraft collisions with METs:
  - On January 10, 2011, a Rockwell International S-2R, N4077X, collided with a MET during an aerial application in Oakley, California.
  - On May 19, 2005, an Air Tractor AT-602, N90172, collided with a MET that was erected 15 days before the accident in Ralls, Texas.
  - On December 15, 2003, an Erickson SH-A Global, N434BW, collided with a MET near Vanaville, Oregon.
- While Wyoming and South Dakota have implemented requirements for METs to improve the safety of low-flying aircraft, not all states have such requirements for METs. (Wyoming maintains an online database of METs and requires all METs to be registered and marked so that they are visible from a distance of 2,000 feet. South Dakota requires that METs be marked.)

# General Aviation (GA) Safety Alerts

March 12, 2013



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# GA Safety Alert Topics

- Aerodynamic stalls at low altitude
- Reduced-visual references
- Aircraft mechanical problems
- Pilots' risk management
- Mechanics' risk management



# Go! Flight 1002



- early starts, multiple segment days, sleep apnea



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Honorable John K. Lauber:

No Accident  $\neq$   
Safe Operation



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# Uncontrolled In-Flight Collision with Terrain

## AIA Flight 808, Douglas DC-8-61, N814CK

### U.S. NAS, Guantanamo Bay, Cuba, August 18, 1993

First NTSB aviation accident investigation  
to cite fatigue as probable cause

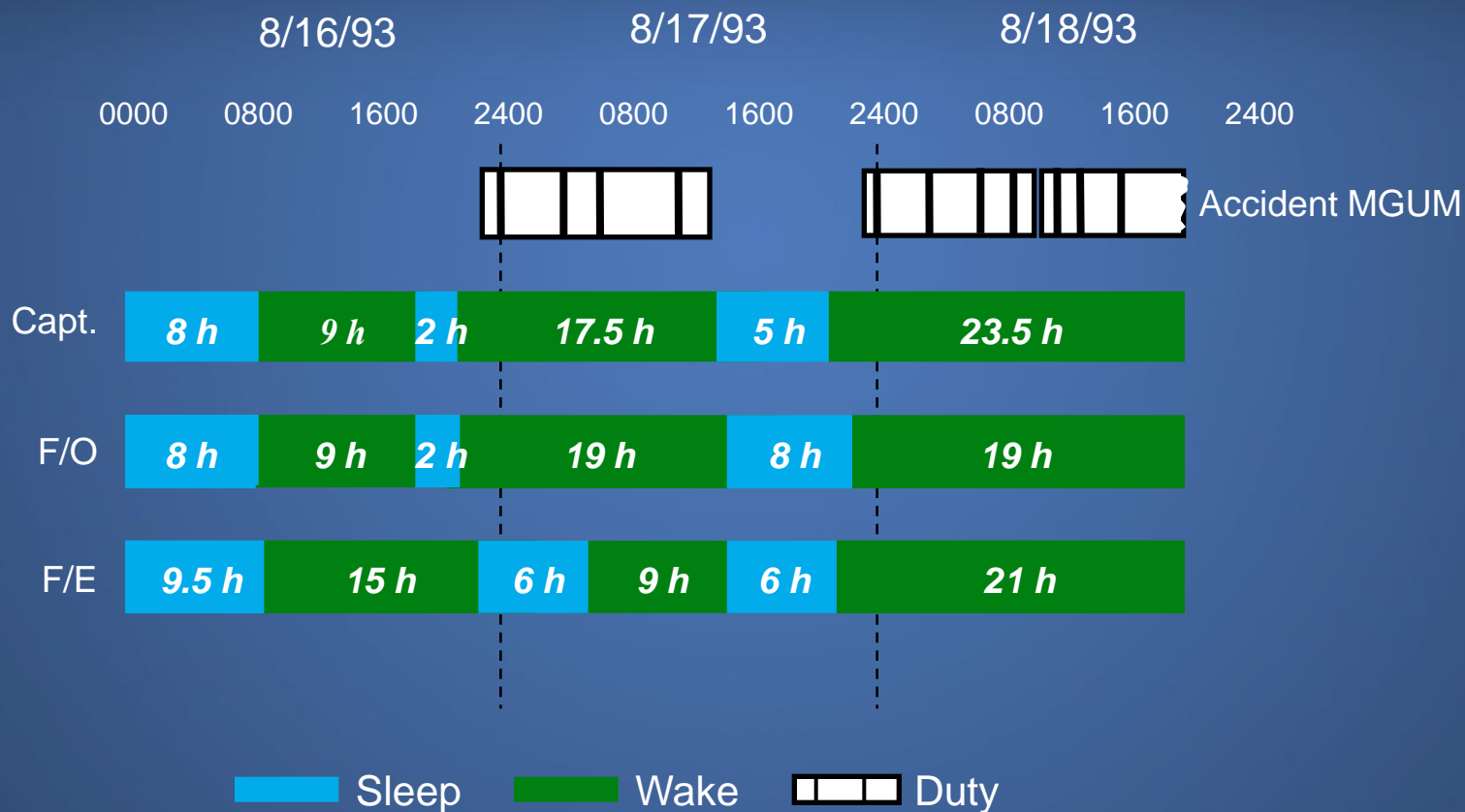


- acute sleep loss, sleep debt, circadian disruption



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# Crew Sleep History





# Observed Performance Effects

- Degraded decision-making
- Visual/cognitive fixation
- Poor communication/coordination
- Slowed reaction time



Uncontrolled In-Flight Collision with Terrain  
AIA Flight 808, Douglas DC-8-61, N814CK  
U.S. NAS, Guantanamo Bay, Cuba, August 18, 1993

“The National Transportation Safety Board determines that the probable causes of this accident were the impaired judgment, decision making, and flying abilities of the captain and flight crew due to the effects of fatigue...”



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# Owatonna, MN (July 31, 2008)



8 fatalities



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# Probable Cause/Contributing Factors

“Contributing to the accident were . . .  
(2) fatigue, which likely impaired both  
pilots’ performance; . . .”



# GA Accident: GULF OF MEXICO (February 17, 1994)

THE PILOT FELL ASLEEP WHILE ENROUTE FROM SPRINGFIELD, KY TO CROSSVILLE, TN WHEN HE AWOKE 5 HOURS LATER HE FOUND THAT HE WAS OVER THE GULF OF MEXICO, 210 MILES SOUTH OF PANAMA CITY, FL, AND HAD ONLY 20 MINUTES OF FUEL REMAINING. HE DECLARED MAYDAY ON 121.5 AND WAS ASSISTED BY COAST GUARD AND AIR FORCE AIRCRAFT. THEY DIRECTED HIM TO THE NEAREST AIRPORT, ST. PETERSBURG, FL WHILE ENROUTE TO THE AIRPORT THE ENGINES QUIT DUE TO FUEL EXHAUSTION AND THE AIRCRAFT WAS DITCHED, 70 MILES WEST OF ST. PETERSBURG. HE WAS RESCUED BY A COAST GUARD HELICOPTER.



# GA Accident: GULF OF MEXICO (February 17, 1994)

- The National Transportation Safety Board determines the probable cause(s) of this accident to be:

THE PILOT'S PHYSIOLOGICAL CONDITION (FAILURE TO REMAIN AWAKE) RESULTING IN EXTENDED FLIGHT OVER WATER FOLLOWED BY FUEL EXHAUSTION, TOTAL LOSS OF ENGINE POWER, AND DITCHING BEFORE RETURNING TO LAND.





# Challenges of a 24/7 Society



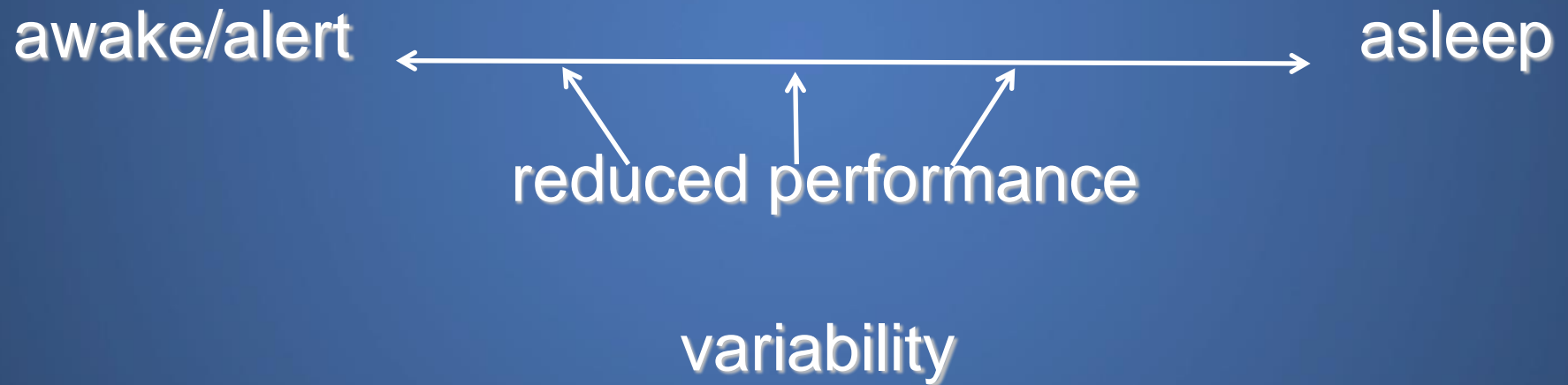
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# Fatigue Risks

Fatigue can degrade  
every aspect of  
human capability.



# Fatigue Risks



# Fatigue Risks

- degraded 20 – 50%+:

- reaction time
- memory
- communication
- situational awareness
- judgment
- attention
- mood

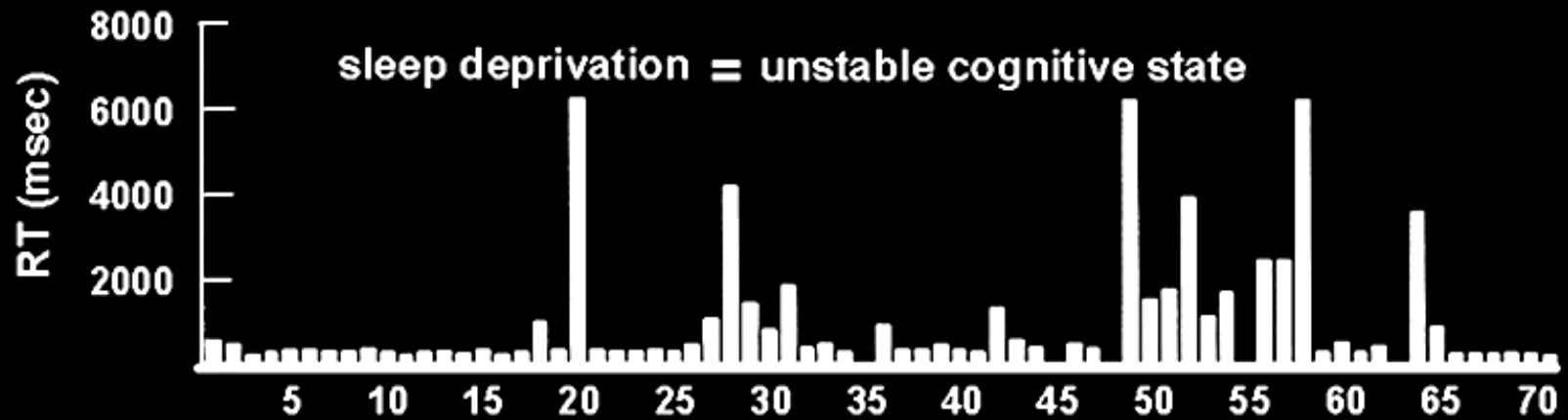
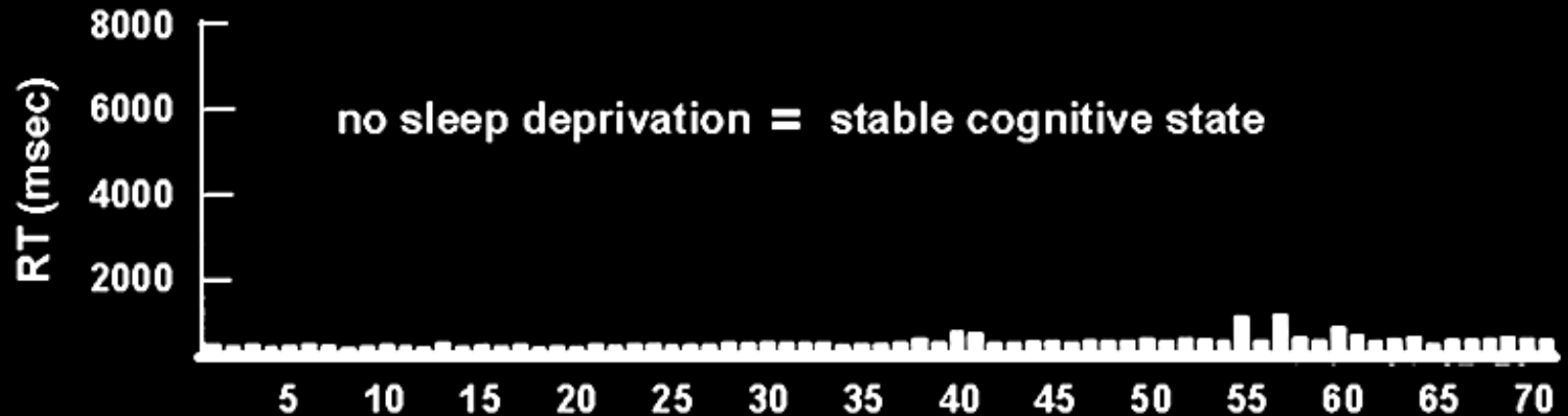
- increased:

- irritability
- apathy
- attentional lapses
- microsleeps





# Fatigue and Reaction Times



consecutive RTs across a 10-min PVT performance task

# Fatigue Factors

- sleep
- circadian clock
- hours awake
- sleep disorders

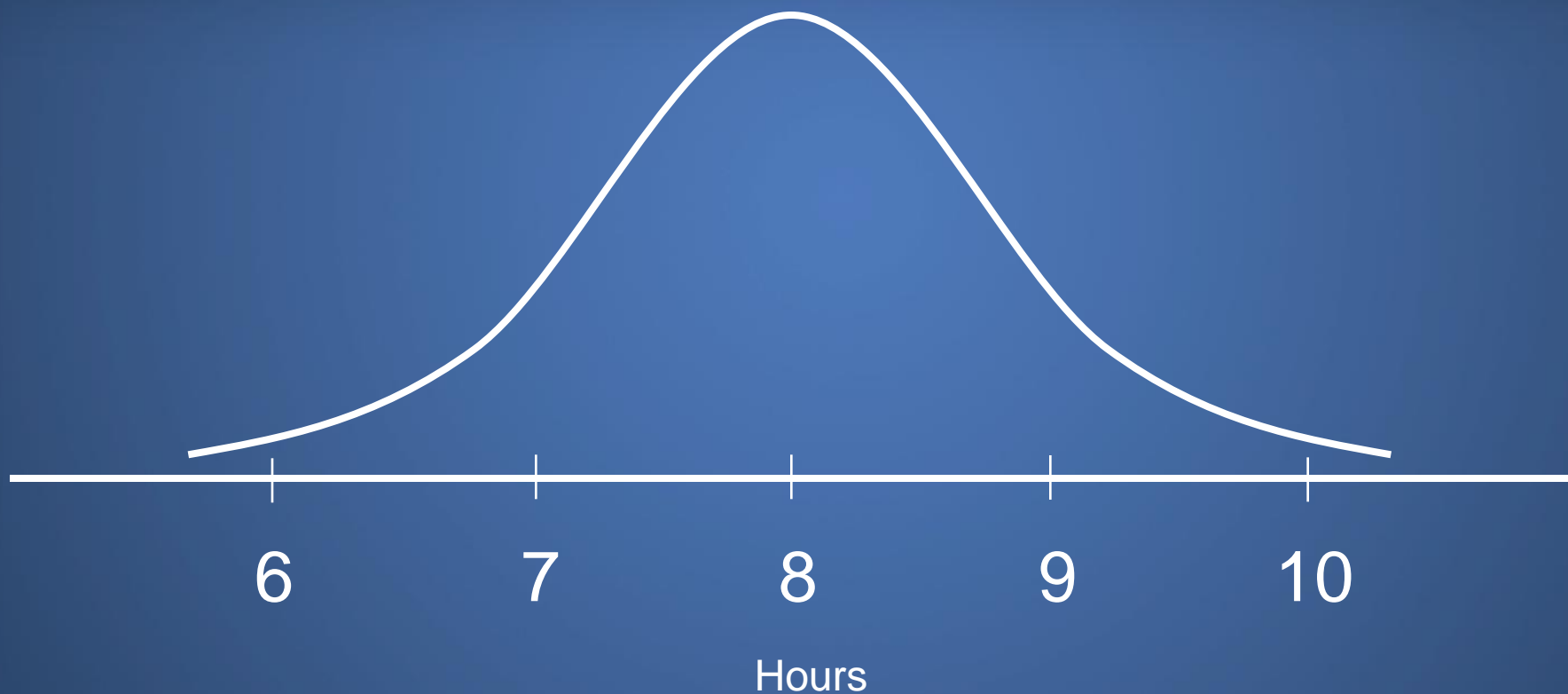


# Fatigue Factors

- sleep
  - acute sleep loss
  - cumulative sleep debt
- circadian clock
- hours awake
- sleep disorders



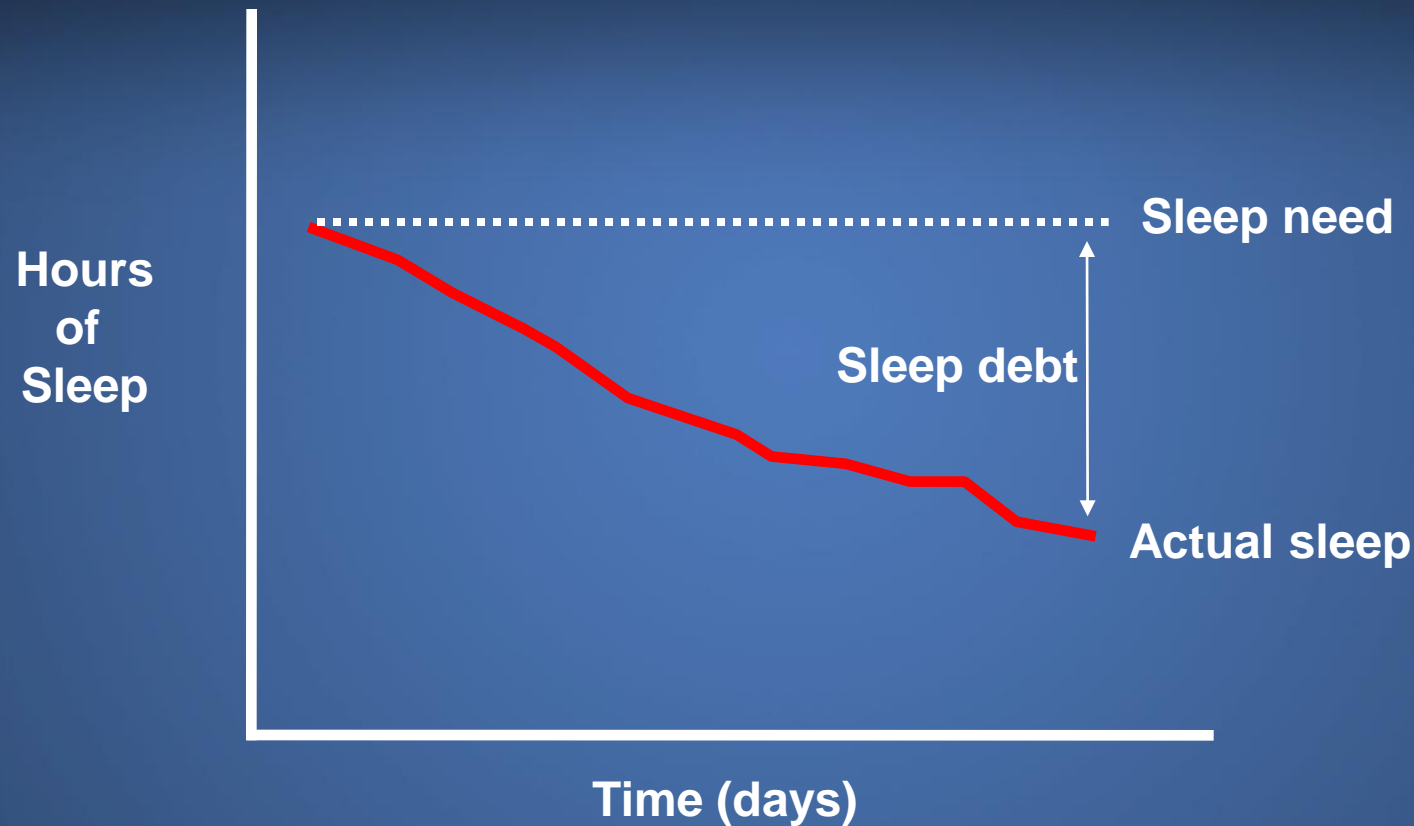
# Sleep Requirement



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# Cumulative Sleep Debt



$\text{Sleep Need} - \text{Actual Sleep} = \text{Sleep Debt}$

Sleep debt grows cumulatively over time



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# Fatigue Factors

- sleep
- circadian clock
  - 'sleepy' windows
  - 'alert' windows
  - irregular schedule
  - time zones
- hours awake
- sleep disorders



# Fatigue Factors

- sleep
- circadian clock
- hours awake
  - > 12 hrs
  - > 16 hrs
  - 24 hrs
- sleep disorders



# Fatigue Factors

- sleep
- circadian clock
- hours awake
- sleep disorders
  - ~ 90 sleep disorders
  - sleep apnea



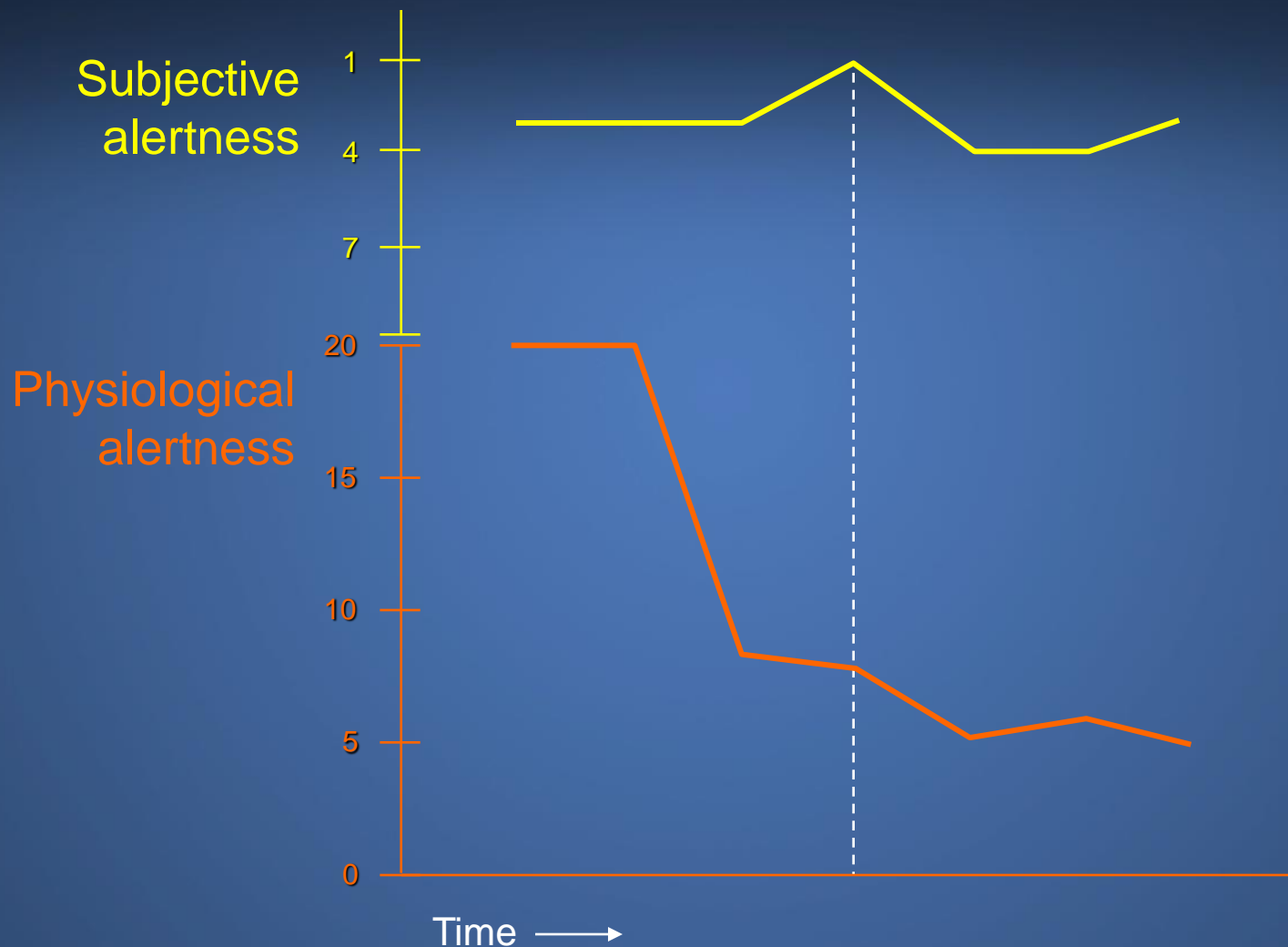


# Fatigue Factors

- sleep
- circadian clock
- hours awake
- sleep disorders



# Alertness Reports Often Inaccurate



Adapted from Sasaki et al., 1986



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# NTSB Safety Recommendations: Fatigue

- 40 years ago: May 10, 1972
- “Revise FAR 135 to provide adequate flight and duty time limitations.” (A-72-55)
- Classified “Closed-Unacceptable”





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### MOST WANTED LIST

A program to increase the public's awareness of, and support for, action to adopt safety steps that can help prevent accidents and save lives. The following are ten of the current issues.



Addressing Human  
Fatigue



General Aviation  
Safety



Safety Management  
Systems



Runway Safety



Bus Occupant Safety



Pilot & Air Traffic  
Controller  
Professionalism



Recorders



Teen Driver Safety



Addressing Alcohol-  
Impaired Driving



Motorcycle Safety



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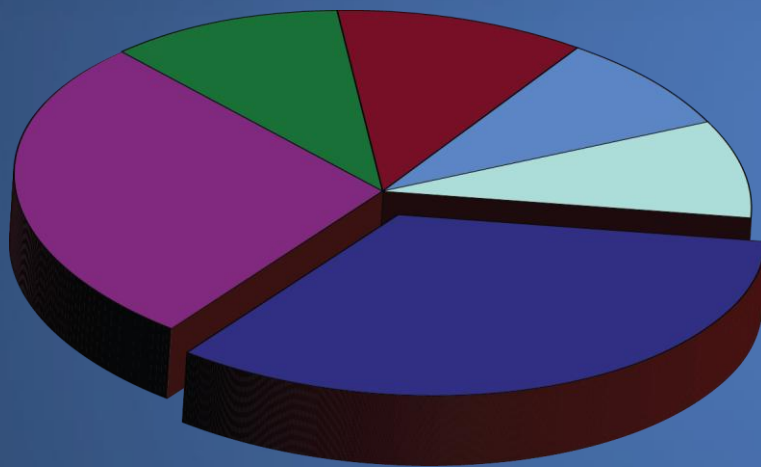
# NTSB Recommendations

- MOST WANTED 1990 - 2012
- ~200 fatigue recommendations



# Complex Issue:

## Requires Multiple Solutions



- Scheduling Policies and Practices
- Education/Awareness
- Organizational Strategies
- Healthy Sleep
- Vehicle and Environmental Strategies
- Research and Evaluation



# NTSB Recommendations: Education/Strategies

- Develop a fatigue education and countermeasures training program
- Educate operators and schedulers
- Include information on use of strategies: naps, caffeine, etc.
- Review and update materials



Good sleep, safe travels.



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